# Interweaved Processor Cores with Acoustically Active Transistors for Self-Cooling Processors

1 December 2022
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## Introduction

There has been a pronounced uptick in demand for improvements of processor cooling mechanisms, particularly where signal amplification in RADAR systems generates large amounts of waste heat that limits the practicality of amplifying weak radar return signals, according to DARPA. The real issue, of course, is that high-resolution radars that operate on hundreds of frequencies at a time with those frequencies constantly changing are highly demanding of processor time. Modern RADAR systems, particularly naval X-Band RADAR (so named for the variability of the frequencies used) perform multiple levels of meta-analysis of received signals.

## Abstract

Not only are returns analyzed to inform the RADAR operator of the likely aircraft type detected, but X-Band RADAR's primary strength lies in the ability to try many frequencies to determine which frequencies best illuminate the target in the case of low-observable aircraft.) The ability to rapidly change frequencies is indispensable for avoiding the effects of jamming signals, as well. As jammers are improved, so must the processors driving X-Band RADAR systems be improved.

My proposal for improving the cooling of such processors (or any processors for that matter) entails creating a processor that functions much like a two-core processor, with a number of important differences. Rather than each core corresponding to a different spatial area of the chip and switching between the use of these cores on the order of every ten seconds or so, I propose the creation of a processor in which two architectures are interweaved, with the processor core utilized alternating thousands of times per second.

Diagram:

ABABABAB
BABABABA
ABABABAB
BABABABA

Neighboring transistors in this system would never be part of the same processor core. Each letter roughly represents a single transistor and the core (either A or B) of which it is a part.

It is first important to understand a principle governing the way in which convection in a fluid inhibits conduction under certain circumstances. This principle's inverse forms the inspiration of my design.

Imagine a rotating fluid surrounded by a static fluid. Convection would ordinarily hasten heat transfer. Heat transfer, however, cannot transpire at a speed greater than the speed of sound in the material in question. While air blowing, for example, over one's skin would cause the skin to be cooled (on a cold day) more quickly than static air, what effect does the overall atmospheric rotation of air have on the tendency of heat to flow from rapidly moving areas to static areas parallel to those flowing areas?

When the direction of motion is parallel, and under the arbitrary condition that there is no gradient connecting the rotating section of the fluid and the static section, the heat transfer between the moving and static sections would actually be diminished. The physical motion of the fluid establishes a kind of momentum that causes heat (and sound) to tend to carry only in the direction of the flow of the fluid. If we take this thought experiment to the extreme, if we could rotate that fluid at the speed of sound with no gradient between the moving and static sections (and no friction,) then these sections would actually behave as if a vacuum exists between them. Any heat transfer would be the result of radiative heat transfer and not due to conduction under that controlled condition.

With that in mind, what are the implications of this principle of phononic momentum for materials that are not fluid, but solid (like a processor,) where the object is to promote the flow of heat away from the processor and not to inhibit it? I came to the conclusion that heat itself could be made to rotate like a fluid within a solid object through the alternation of the nano-scale spaces heated, provided that conditions were ideal. This rotation of heat would accelerate the dissipation of heat through conduction, a passive form of cooling.

The rate of cooling of an object is proportional to its surface area. In my earlier work in cosmology, I identified temperature as a dimension. Treating heat as a dimension instead of a mere property, the surface area through which heat can dissipate through an object can be enhanced by creating "cool corridors" of a zig-zag configuration by alternating the use of the A and B "cores" of the processor. The direction of heat flow can be controlled through this alternation as can the quantity of heat channeled. Although the path the heat would take is more circuitous, all of the heat eventually makes it to the edge of the chip.

While this design would in and of itself constitute an incremental improvement in terms of passive cooling, with a slight modification, this basic concept can be expanded to create a processor that is truly self-cooling, potentially facilitating operating temperatures lower than idle temperatures.

In physics, heat, pressure, and sound are closely intermingled. Sound can lead to an increase in temperature as structured phononic waves lose their integrity and degenerate into micro-vortices. Heat, although it alters pressure in a fluid, tends to create unstructured phonons that emanate in all directions. Increases in heat tend to lead to increases in pressure which can eventually become an overpressure wave. In solids, this does not occur.

Heat cannot flow through a material faster than the speed of sound in that same material. Since we know that A.) Sound can act as a carrier for heat and B.) Heat tends to move at about the speed of sound, we can deduce that the controlled production of colliding sound waves within such a system can neutralize heat energy using opposing phononic waves.

Transistors, while they tend to produce heat when electrified, do not tend to produce sound. If they did produce sound, that sound could be used to draw away a portion of the heat associated with each clock cycle.

To achieve this, I propose the addition of a spherical bubble in the middle of each of the nanowires just prior to the point where electrons enter into the transistor from the wire. The bubble would be a vacuum containing nothing through which the electrons could pass through, forcing them to alternate between circumnavigation of that bubble on either the left or right margin of the wire.

This alternation would not impede the function of the transistor, but it would result in the generation of acoustic energy resulting from an internal tug of war between building heat energy in the form of phonons and the Coulomb repulsion of the electrons. Without this additional mechanism, heat energy in the transistor would start dissipating immediately, but would be disorganized as it would not be part of a sound wave. By alternating the side of the transistor electrified, phononic energy accumulates and is synchronized before its release. A metaphor would be pouring water into a glass with no bottom (but a tight seal against the table) and then suddenly lifting the glass away, creating a cascade of water, as opposed to simply pouring water onto a table with no glass to constrain the flow of water, even temporarily.

The ideal rate of alternation for transistor groups A and B would be about a quarter of the time it takes for sound to travel the distance between transistors so as to cause waves of heat coupled with sound to annihilate halfway between transistors. Any heat not eliminated in this unique active cooling mechanism would be efficiently drawn away through the "cool channels" that provide numerous pathways for heat to follow in support of enhanced conductive cooling.

## Conclusion

Although existing doctrine states that an even distribution of heat within processors is ideal, in this case, a structured disequilibrium is created on not one but two levels and both serve to enhance function rather than impeding it.